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THE ARTIFICIAL PALATE.

One Way of Making It and of Keeping Its Records.

THE artificial palate is one of the results of the many efforts to locate, and thus to study, the position of the tongue with reference to the palate and the teeth in the pronunciation of sounds. Something of the history of the palate, and a number of ways of making the same, are given by M. l'abbé Rousselot. The purpose of this paper, therefore, is simply to suggest another method of making the palate, and one which for simplicity and cheapness of manufacture, and for the greater exactitude it offers in final results, seems to have some advantages over anything described in the *Principes.*[1]

The object aimed at in the artificial palate is to obtain some instrument which shall be of such slight bulk, and shall conform so closely to the formation of the hard palate, as to make any position which the tongue may take in regard to this artificial palate a practically correct record of the tongue upon the hard palate itself.

The necessary materials to be provided for work are, an impression cup and modelling compound, such as a dentist uses for taking the impression of the upper portion of the mouth in the manufacture of a plate of teeth, a few cents worth of Plaster of Paris, a small amount of varnish, and, most important of all, a few ounces of gutta percha. The gutta percha as used by dentists in the preparation of the temporary plate is the kind needed, and may be obtained from any store which handles dental supplies. It comes in thin sheets, about three by five and three quarter inches, surface measurements, and for best results should not be over a twentieth of an inch in thickness. If it be impossible to obtain it satisfactorily thin it may be placed in hot water for a moment to soften and then rolled somewhat thinner. It should not be thinned by stretching.

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[1] *Principes de Phonétique Expérimentale* par L'abbé Rousselot (H. Welter, Paris and Leipsic), Part I, p. 53 ff.

Any one who really wishes to learn how to manipulate the various articles mentioned above should go to a dentist and see the work done, then try it himself under the dentist's directions. A short description of the method of work may, however, not be out of place. The impression cup may, in a general way, be compared to a spoon. If one imagine a spoon of tin or zinc alloy, with a handle about two inches long and a trifle under an inch wide, projecting straight out from the base of the bowl instead of being curved as in the ordinary spoon, the bowl itself about two inches in length and two and a half inches wide, open and square cut at the end, the sides sloping more abruptly than in an ordinary spoon, the bottom flat towards the rim and arched upward about half an inch in the center—if one can imagine this, he will have a fair picture of an impression cup. The modelling compound, a preparation of wax, comes in small round cakes about a quarter of an inch in thickness and three and a half inches in diameter. There are three grades, hard, soft, and medium. The latter seems to be preferable.

The modelling compound is placed in very hot water till soft, then transferred to the impression cup, filling the whole, but not projecting over the sides. To get a clear impression of the mouth there should be no creases on the surface of the wax. Care should also be taken to have the wax sufficiently cooled to prevent burning the mouth. One should be able to place the wax against the cheek without discomfort. The whole is then introduced into the mouth and pressed firmly against the palate and upper teeth. It should be held here till the modelling compound has had time to harden somewhat, then taken from the mouth and placed for a moment in cold water till the wax becomes cool and perfectly hard.

So far this is the method that would be followed by any dentist, but at this point I found it necessary to make a change in the method of procedure, and that for the following reasons. In working with the palate I had had made of hard rubber I found that it was very difficult, having obtained a record upon this palate, to transfer the record to paper with sufficient accuracy to let me feel that I could speak with authority as to just what my tongue had done. This was especially the case, when I wished to compare sounds which were much alike in their formation. On the palate one has a record made on a surface with very complex curves. To transfer that record to a flat surface is theoretically impossible, and practically very difficult.

My aim, therefore, was to get a surface, which for practical purposes, was exactly like the one on which the record was made by the tongue. This could be accomplished in a variety of ways, but after a number of unsuccessful attempts I finally adopted the following method which I found thoroughly satisfactory. The impression of the palate in the modelling compound I marked off into small squares, about five millimeters to the side. Then, following the lines of these squares, I covered the surface of the impression with a series of small grooves, being careful not to make my lines too broad.

Next comes the plaster cast from the impression thus completed. It is well not to use any material with the plaster to hasten the hardening process, for this weakens the cast, and it is well to have a cast that will give long service. It is also desirable to have the plaster near the hardening point before making the cast, and in applying it, in order to prevent air bubbles in the cast, to jar the plaster by thumping the bottom of the impression cup against some hard object. Give the model a good generous coating. It can be trimmed down afterwards to proper and more graceful proportions. When the plaster is hardened, a matter of but a few moments, trim away the cast to the outside edges of the wax impression and place the whole in hot water in order to loosen the modelling compound from the cast. The wax will have a tendency to stick, but by pressing the parts already removed against the portions that still hold, the latter will readily be taken up and there will be no trouble in securing a clean cast. This will, of course, show the impression of teeth, gums, and hard palate, and, what is more important still for the final results, the series of small squares, which now, of course, appear on the surface as tiny ridges. The cast should now be trimmed down to smaller proportions, as it will be much easier to handle if not too bulky.

If it be necessary to have the artificial palates at once there is no objection to immediately proceeding with the work. If there is plenty of time to spare the cast may be allowed to dry out thoroughly and then be given a coat of varnish. Shellac varnish, made by dissolving shellac in alcohol, has the advantage of drying very rapidly. A good clear carriage varnish makes the cast very neat and hard, but this will require a full day for drying. When the varnish is thoroughly dry the whole surface of the cast should be gone over with some substance to keep the gutta percha from sticking to it. Talcum powder or ground soapstone is satisfactory. If the work is taken up at once, without varnishing, the powder should be applied before placing the cast in water as described in the next paragraph.

The first gutta percha palate I made from the plaster cast cost me about forty-five minutes. I can now make five or six an hour, and with a little practice any one else can do the same. The money cost of each palate, once the cast is made, is only about ten cents. With the completed cast before one the next step is to produce the final palates. Take half as many sheets of gutta percha as there are palates to be made, and cut each sheet through the middle, from side to side. The resultant small sheets will be almost square and just the proper size for making the palates. Place also on the table before you two cups and a bowl, the latter sufficiently large to permit working in it with the fingers. The first cup should be filled with boiling water, the second with cold, the bowl should be filled with water not too hot to prevent one's working in it with his fingers. Into the cup of hot water dip a square of gutta percha till it softens, then transfer it to the bowl and over the face of the cast, working it down with the fingers and thumbs till it conforms to the shape of the cast. Care should be taken not to stretch the gutta percha more than is necessary. This accomplished, transfer the cast with the gutta percha to the cup of cold water. The gutta percha will harden in a moment and may then be removed. Continue this process till as many palates are made in the rough as are desired, for it is better to carry one operation through on all the palates than to bring one palate to completion before taking up another.

When the required number of palates is finished in the rough they should all be trimmed down to more exact proportions with a small pair of scissors. All the material back of the middle of the wisdom teeth must be cut away, for otherwise the artificial palate will be affected by the motions of the soft palate and the results will be unsatisfactory. Then trim away all material outside of a line which may be thought of as extending along the middle of the inside walls of the molars. At the rear bicuspid let the line of cutting rise towards the grinding edge of the tooth, and continue upwards to, or over, the inner cusp of the front bicuspid. From along the front teeth cut away about half way down on the teeth. Each palate should then be placed again upon the cast and worked down upon the same till the details are well brought out and it is a perfect fit. To obtain the necessary malleability the gutta percha and cast may be held over a lamp and worked while hot, the fingers being moistened to prevent their sticking to the gutta percha. If this is not too thick, and if the ridges upon the cast are sufficiently strong, the whole series of lines upon the cast will show through. If they do not, the points of intersection may be brought out upon the face of the palate by pressure from behind with a pin or some other pointed instrument.

It will be found that the palates thus made are a trifle lacking in rigidity. For those to which the records are to be transferred for final keeping this makes no difference. The one palate which is to be used for taking records in the mouth, however, must be more rigid, it is also necessary that this palate should offer a black surface. One process will serve both purposes. Any black varnish will do the work. If no other kind may be had a good black may be obtained by dissolving a small amount of lampblack in the shellac varnish mentioned above. If the formation of the teeth will permit, it will also be well to give the palate some sort of a handle. Three quarters of an inch cut off from the end of a pin and pushed into the palate at some intersection of the teeth, not back of the bicuspids, will furnish this. It should not project beyond the teeth sufficiently to interfere with the free movement of the lips. The dry surface of this black palate is then sprinkled with some white powder, talcum powder is convenient and not unpleasant, and placed in the mouth. The powder will then be removed from any point at which the tongue touches the palate. This is the record of the sound produced. Remove the palate from the mouth, and with a small brush and water colors or India ink reproduce upon one of the unblackened palates the lines of contact as shown upon the recording palate removed from the mouth. The copy can be made with practical exactitude because the surface of the two palates are exact duplicates.

For ordinary purposes a single palate will take four records. By using different colors for recording different sounds there will be no confusion. When any one palate has a finished set of records it may be given a coat of varnish. Thin transparent carriage varnish is excellent. The records can then be kept indefinitely.

It will be well to bear one or two points in mind. One should start his experiments with a comparatively simple sound. A vowel in connection with a single consonant is best. The reason for this is that the average English speaking person cannot, without much practice, pronounce a single clear cut vowel. Our so-called vowels, a, e, i, o, u, are all diphthongs, but if we shut in a vowel before and behind with a consonant we can, as a rule, without a great deal of trouble attain to a clear vowel. There is, for example, a large difference between long English a (ā) as it is pronounced standing alone and ā in bābe. Still more difficult is it to make certain of an English a as in can't unless it be surrounded by consonants.

There are undoubtedly very few language teachers who can take the time to engage in extended phonetic studies, but it is of the utmost importance to every language teacher to know his own mouth, and what is happening therein when he pronounces a given sound. There is scarcely any way to obtain this knowledge more easily and with more practical exactitude than by means of the artificial palate.

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